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Thursday
May 17, 1984

U.S. DEPARTMENT OF TRANSPORTATION

Part V

**Department of
Transportation**

Federal Aviation Administration

14 CFR Part 121

**Airplane Cabin Fire Protection; Proposed
Rule**

DEPARTMENT OF TRANSPORTATION**Federal Aviation Administration****14 CFR Part 121**

[Docket No. 24073; Notice No. 84-5]

Airplane Cabin Fire Protection**AGENCY:** Federal Aviation Administration (FAA), DOT.**ACTION:** Notice of proposed rulemaking (NPRM).

SUMMARY: This notice proposes equipment requirements to improve cabin fire protection for passenger-carrying transport category airplanes operated under Part 121, after a specified date. This notice proposes that each lavatory and galley be equipped with a smoke detector system, which provides warning to the cockpit or to the passenger cabin crew. Also proposed is a requirement that each lavatory trash receptacle be equipped with a fire extinguisher which discharges automatically upon occurrence of a fire within the receptacle. This notice also proposes to increase the number of hand fire extinguishers located in the passenger cabins of airplanes with passenger seating capacities greater than 60 and to require that at least 2 of the hand fire extinguishers installed in the passenger cabin have halon 1211 as the extinguishing agent. These proposals are the result of investigations of in-flight fires and an inspection survey of the U.S. air carrier fleet indicating the need for an increase in protection against possible in-flight fires.

DATES: Comments must be received on or before September 14, 1984.

ADDRESS: Comments on the proposal are to be marked with "Docket No. 24073" and mailed in duplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attn: Rules Docket (AGC-204), Docket No. 24073, 800 Independence Avenue, SW., Washington, D.C. 20591; or delivered in duplicate to: Room 916, 800 Independence Avenue, SW., Washington, D.C. Comments may be inspected at Room 916 on weekdays, except Federal holidays, between 8:30 a.m. and 5 p.m.

FOR FURTHER INFORMATION CONTACT: Henri Branting, Technical Analysis Branch (AWS-120), Aircraft Engineering Division, Office of Airworthiness, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, D.C. 20591; Telephone (202) 426-8382.

**SUPPLEMENTARY INFORMATION:
Comments Invited**

Interested persons are invited to participate in this rulemaking by submitting written data, views, or arguments and by commenting on the possible environmental, energy, or economic impact of this proposal. The comment should carry the regulatory document or notice number and be submitted in duplicate to the address above. All comments received, as well as a report summarizing any substantive public contact with FAA personnel on this rulemaking, will be filed in the docket. The docket is available for public inspection both before and after the closing date for making comments.

Before taking any final action on the proposal, the Administrator will consider any comment made on or before the closing date for comments. The proposal may be changed in light of comments received.

The FAA will acknowledge receipt of a comment if the commenter submits with the comment a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. 24073." The comment is received, the postcard will be dated, time stamped and returned to the commenter.

Availability of NPRM

Any person may obtain a copy notice of proposed rulemaking by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Information Center, APA-430, 800 Independence Avenue, SW., Washington, D.C. 20591, or by calling (202) 426-8058. Requests should be identified by the docket number proposed rule. Persons interested in being placed on a mailing list for proposed rules should also request a copy of Advisory Circular No. 1, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

Background

This notice is a result of investigations of recent aircraft cabin fires which indicate that additional measures are needed to enhance protection against such fires. One fire occurred near Cincinnati, Ohio, on June 2, 1983, and resulted in 23 fatalities. Another occurred at Tampa International Airport in Florida on June 25, 1983, and resulted in evacuation of the airplane with no injuries or loss of life. An inspection survey of the U.S. air carrier fleet was conducted recently by the FAA as part of the FAA air carrier airworthiness surveillance program. The proposals in

this notice are appropriate in light of the inspection survey results. The survey was conducted to determine the effectiveness of previous FAA actions, discussed below, to correct deficiencies in fire protection and to determine whether or not the results of the corrective actions adequately serve the objectives and provide adequate safety. The survey entailed inspections and investigations by FAA air carrier inspectors of fire containment capabilities of trash receptacles in transport category airplanes. Many of the receptacles inspected revealed that the fire containment capabilities of trash receptacles may be compromised by the wear and tear typical of service. Considering the seriousness of in-flight cabin fires, an expanded approach to fire protection is considered necessary.

After an in-flight fire several years ago aboard a Varig airliner, which originated in a lavatory area, the following corrective actions were taken. The FAA issued an airworthiness directive (AD 74-09-08, Docket No. 13603), applicable to all transport

electrical components and installation of lavatory trash receptacles to ensure fire containment. Together, the AD actions were intended to eliminate likely ignition sources, end smoking in lavatories, and provide fire-safe trash receptacles in the event that fire occurs in a receptacle despite these precautions. As indicated by the investigations of recent cabin fires, additional measures may be necessary to improve the level of fire safety.

In addition to these AD actions, a study was conducted under FAA contract which included the conceptual design and feasibility analysis of a total cabin integrated fire management system. This study included analysis of

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Before taking any final action on the proposal, the Administrator will consider any comment made on or before the closing date for comments. The proposal may be changed in light of comments received.

The FAA will acknowledge receipt of a comment if the commenter submits with the comment a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. 24073." When the comment is received, the postcard will be dated, time stamped and returned to the commenter.

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Background

This notice is a result of investigations of recent aircraft cabin fires which indicate that additional measures are needed to enhance protection against such fires. One fire occurred near Cincinnati, Ohio, on June 2, 1983, and resulted in 23 fatalities. Another occurred at Tampa International Airport in Florida on June 25, 1983, and resulted in evacuation of the airplane with no injuries or loss of life. An inspection survey of the U.S. air carrier fleet was conducted recently by the FAA as part of the FAA air carrier airworthiness surveillance program. The proposals in

this notice are appropriate in light of the inspection survey results. The survey was conducted to determine the effectiveness of previous FAA actions, discussed below, to correct deficiencies in fire protection and to determine whether or not the results of the corrective actions adequately serve the objectives and provide adequate safety. The survey entailed inspections and investigations by FAA air carrier inspectors of fire containment capabilities of trash receptacles in transport category airplanes. Many of the receptacles inspected revealed that the fire containment capabilities of trash receptacles may be compromised by the wear and tear typical of service. Considering the seriousness of in-flight cabin fires, an expanded approach to fire protection is considered necessary.

After an in-flight fire several years ago aboard a Varig airliner, which originated in a lavatory area, the following corrective actions were taken. The FAA issued an airworthiness directive (AD 74-09-08, Docket No. 13603), applicable to all transport category airplanes. The AD requires 1,000-hour periodic inspections, and repairs as necessary, of all lavatory trash receptacles to ensure fire containment capability. The AD also requires preflight briefings informing passengers not to smoke in lavatories, the installation of ash trays near lavatory entrances, and the installation of no-smoking signs on each side of lavatory doors. Subsequent to issuance of the AD's, 14 CFR 25.853 was amended to incorporate these requirements for ashtrays and no-smoking signs. Section 121.571 requires that passengers be given preflight briefings regarding smoking. Three additional AD's (AD 74-21-03, AD 75-02-04, and AD 75-02-05; Docket Nos. 73-NW-12, 74-WE-10, and 74-WE-11, respectively) were issued for specific airplane models requiring inspection and repair of lavatory electrical components and modification of lavatory trash receptacles to ensure fire containment. Together, the AD actions were intended to eliminate likely ignition sources, end smoking in lavatories, and provide fire-safe trash receptacles in the event that fire occurs in a receptacle despite these precautions. As indicated by the investigations of recent cabin fires, additional measures may be necessary to improve the level of fire safety.

In addition to these AD actions, a study was conducted under FAA contract which included the conceptual design and feasibility analysis of a total cabin integrated fire management system. This study included analysis of

fire-related accident and incident data taken over a 10-year period; a survey of available technology; and analysis of fire detection, monitoring, and extinguishing options for all areas of a typical wide-body passenger cabin. While technical problems precluded adoption of the total cabin integrated system as a practical fire protection standard for large cabins in general, the study did provide sound data on fire protection, some of which is pertinent to the proposals in this notice. Components of the integrated system, such as the galley and lavatory smoke detectors included in this proposal, have not been proposed for incorporation into regulations before this time because the specific corrective actions taken were, until the recent inspection survey, deemed to ensure adequate fire protection. The results of this study are contained in department of Transportation (DOT) Report No. FAA-RD-76-54, Feasibility and Tradeoffs of a Transport Fuselage Fire Management System, dated June 1976, available from the National Technical Information Service (NTIS), Springfield, Va. 22151.

The FAA also conducted cabin fire extinguishing tests using various types of hand extinguishers. These tests demonstrated that for a fire in a large aircraft cabin, the halon 1211 extinguishers are safe from the standpoint of toxicity and far more effective in range and knockdown capability than other extinguishers currently in service. The results of the hand extinguisher tests are contained in DOT Report No. DOT/FAA/CT-82-11, Inflight Aircraft Seat Fire Extinguishing Tests (Cabin Hazard Measurements), dated December 1982, available from NTIS. Halon 1211 extinguishers are rated for class A, B, and C fires. Under the air carrier airworthiness surveillance program, FAA issued a general notice (GENOT), dated November 29, 1980, to inspectors and air carrier operators encouraging the installation of at least two halon 1211 extinguishers in each airplane on a voluntary basis. The operators have indicated their intention to install the extinguishers on nearly all airplanes in the fleet, and many airplanes currently have them installed.

Discussion of Proposal

This notice proposes regulations which require transport category airplanes operating under Part 121 to be equipped with smoke detectors to enhance the detection capabilities of flight attendants and with increased fire extinguishment capabilities, for those area of the passenger cabin shown by

experience to be more critical for fire protection.

The proposals would require smoke detectors systems in galleys since galleys have the highest incidence of flame, smoke, and overheat conditions in the passenger cabin. The proposals would also require smoke detector systems in lavatories. While lavatories have a lower smoke and fire incident rate than galleys, they are more sensitive from a fire detection standpoint because they are more often unattended, they are closed from view by a door, and they contain ventilation systems designed to keep odors, and thus sensory smoke warnings, away from the passenger cabin. The galley and lavatory detector systems would be required to provide a warning light in the cockpit or a warning light or audio warning in the passenger cabin which provides a clear and unmistakable signal, readily detectable by a flight attendant, taking into consideration the positioning of flight attendants throughout the flight. Because the galley and lavatory smoke detectors would serve to enhance the present ability of the flight attendants to visually detect fires in the cabin and not as primary detection systems such as those used in isolated cargo compartments, it would be unnecessary for the detectors to meet all of the performance and environmental requirements in Technical Standard Order C1b, which are applicable to the type of primary detectors used in isolated cargo compartments. Service experience has shown that nearly all galley and lavatory fires are detected by cabin personnel early enough to allow prompt control and extinguishment. In this case, a commercially available smoke detector, such as the type commonly used in residential buildings, which is demonstrated to serve its intended function as installed, could be considered adequate under the proposals. One airline which has already voluntarily installed this type of detector in lavatories has had a most favorable service experience with the detector.

The proposals would require that lavatory trash receptacle be equipped with automatic fire extinguishers. This type of extinguisher could be a small extinguishant-charged bulb with a thermal fuse plug. This type currently is in service in trash receptacles in numerous transport category airplanes.

The lavatory smoke detectors and automatic fire extinguishers would be in addition to the fire containment capability currently required for lavatory trash receptacles because, as

indicated by the recent inspection survey, fire containment capability is subject to deterioration in service, and additional measures of fire protection may be necessary. The automatic fire extinguishers would counter a fire as quickly as possible at its inception and would be a practicable means of keeping response time to a minimum, which is a key principle of fire protection in general. The smoke detectors would be necessary complement to the extinguishers to enable crewmembers to quickly detect a fire and determine if additional actions, such as use of hand extinguishers, are necessary to control the fire and prevent rekindling. The requirement for trash receptacle fire containment capability would be retained since containment capability, degraded or not, delays the propagation of fire and provides a needed incremental measure of fire protection.

Because it has been determined that halon 1211 demonstrates superior performance and effectiveness in combating fires, the proposals would also require that at least 2 halon 1211 hand fire extinguishers be installed in the airplane cabins. This is consistent with the GENOT issued under the air carrier airworthiness surveillance program, encouraging the installation of halon 1211 extinguishers. In addition, the proposals would increase the number of hand fire extinguishers required by § 121.309 to be located in the passenger compartments of transport category airplanes. Section 121.309 currently requires at least 2 fire extinguishers for airplanes accommodating more than 30 passengers. The airworthiness regulations applicable to nearly all transport category airplanes in the U.S. air carrier fleet require that at least 3 fire extinguishers be located in passenger compartments of airplanes having passenger capacities greater than 60. The proposed requirements would be consistent with existing airworthiness regulations for passenger capacities up to 200. For capacities greater than 200, the proposals would require 1 additional extinguisher for each increment, or fractional increment, of 100 passengers. This reflects the current general fleetwide practice regarding the installation of fire extinguishers in the larger airplanes, many of which are equipped with an even greater number of extinguishers than specified in the proposals.

The proposals would require that airplanes operating under Part 121 comply within 1 year after the regulations become effective. The 1 year

period is intended to allow air carriers lead time to schedule the aircraft modifications necessary for compliance to coincide with major maintenance inspections and to develop appropriate maintenance and crewmember procedures and instructions. The FAA specifically requests comments on the adequacy of this 1-year implementation period.

Benefits

Benefits to the smoke detector and fire extinguisher proposals will be the prevention of potential fatalities, injuries, and property damage resulting from fires originating in galleys, lavatories, and other areas in the passenger cabin. Estimating these benefits quantitatively is complicated by the relatively limited number of in-flight cabin fire accidents. However, when such accidents have occurred, the losses have been catastrophic. A probability analysis has been utilized to estimate the risk of catastrophic cabin fires and the potential benefits which might result from the proposed regulations. This approach combines informed judgment about the nature and location of cabin fire hazards, as well as the effectiveness of the proposed countermeasures, with statistical techniques which systematically treat the uncertainty inherent in such judgments. The analysis generates a range of benefit values and a probability distribution of achieving these benefits which can be compared to the estimated costs of the various proposals.

A Poisson distribution has been used to estimate the probability of experiencing random cabin fire accidents during the 10-year period of the analysis. The Poisson distribution provides a realistic model for predicting many random phenomena and frequently is used in safety analyses to estimate accident risk in a future time period.

The Poisson distribution of potential future catastrophic cabin fire accidents represents the risk associated with maintaining the status quo and provides a baseline from which the potential benefits of the proposed regulations can be measured. To develop the Poisson distribution for this analysis, it was first necessary to determine the historical average rate of catastrophic in-flight fires believed to have originated in the passenger cabin. Post-crash fires, flight-deck fires, belly cargo fires, fires aboard freighter aircraft, and all other fires not believed to have originated in the passenger cabin were excluded in establishing this baseline. The only two major cabin fire accidents in worldwide operations, the Varig Boeing 707 fire in

Paris in July 1973 and the Air Canada DC-9 fire at Cincinnati, Ohio, in June 1983, suggest an average historical rate of two random catastrophic cabin fire accidents during a 10-year period. The Poisson distribution based upon this average ranges from 0 to 9 potential accidents, with the highest probabilities concentrated about the mean value of 2.

Based upon traffic data tabulated in the *FAA Statistical Handbook of Aviation*, FAA estimates that an average of 100 persons (including crew) are carried aboard a typical Part 121 passenger operation. The average fatality rate of 75 percent from the 2 accidents cited previously yields an estimate of 75 fatalities per accident. Applying the standard value of \$650,000 per statistical fatality used in FAA regulatory evaluations, adding the standard average air carrier hull value of \$7,750,000 for a destroyed aircraft, and discounting this total as uniform series of payments over the 10-year period of the analysis (to allow for the random nature of such accidents which may occur anywhere within that period) at the 10 percent discount rate prescribed by OMB yields an average accident cost of \$36,425,550.¹ This will be the average benefit realized for every accident prevented by the proposals in this rulemaking.

Probability distributions have also been developed to estimate the frequency that a potential accident will involve a location or scenario where each of the protective measures proposed in this notice would be operative, and should such a fire scenario occur, what would the probable effectiveness of a particular protective measure be in preventing that accident. The benefits which would result for each combination of parameter values—i.e., the number of potential accidents, the percentage of those potential accidents having scenarios and locations where a particular protective measure would be operative, and the percentage of occurrences where the protective equipment would be effective in preventing the accident—have been calculated, generating a probability distribution of potential benefits resulting from each proposed requirement. The expected benefit value, equal to the sum of the products of each possible benefit value and its associated probability, has also been calculated and represents an average of

all of the possible benefit outcomes weighted by their respective probabilities.

Developing estimates of the benefits attributable to the lavatory smoke detector and to the automatic fire extinguisher in the lavatory trash receptacle requires that some allocation be made of those potential future accidents which could be expected to originate in the lavatory. These potential accidents need to be allocated further into those in which the smoke detector would be the piece of protective equipment relied upon to prevent the accident and those which would rely upon the automatically discharging fire extinguisher in the trash receptacle.

In both of the catastrophic accidents cited above, the fire likely originated in the lavatory. However, Service Difficulty Reports (SDR's), maintained by the FAA's National Safety Data Branch in Oklahoma City, indicate that only 12.1 percent of in-cabin smoke and fire incidents occur in the lavatory. The SDR data indicate that the vast majority of these incidents, 64.3 percent, occur in aircraft galleys, and the remaining 23.6 percent occur in other areas of the cabin. Although none of the catastrophic cabin fires experienced to date are thought to have originated outside of the lavatory, some allowance must be made for the possibility that a major fire could originate in one of the locations where 87.9 percent of the smoke and fire incidents historically have occurred. Lavatory fires are particularly insidious, however, because fires in closed lavatory compartments are more likely to go undetected than in other areas of the cabin.

For the purposes of this analysis, the FAA assumes that over a prolonged period of time, an average of 80 percent of all random catastrophic cabin fire accidents would originate in the lavatory, and the remaining 20 percent would originate elsewhere in the cabin.

Of the two previous accidents which are believed to have originated in the lavatory, the Varig accident involved a fire originating in the trash receptacle, and although the National Transportation Safety Board has not yet issued its final report, testimony given during the investigation indicates that the Air Canada fire was electrical in origin. This suggests that potential accidents might be evenly divided between those in which the smoke detector and those in which the trash receptacle fire extinguisher would be the operative piece of protective equipment. However, the inspection survey discussed previously revealed that the fire containment capabilities of a trash

¹ See *Economic Values for Evaluation of Federal Aviation Administration Investment and Regulatory Programs*, FAA Office of Aviation Policy and Plans, September 1981 (Report No. FAA-APD-81-3). Values have been adjusted for inflation as prescribed in this guide.

receptacle can become compromised by the wear and tear typical of service. In these instances, the lavatory smoke detector would be the more significant piece of equipment in preventing a trash receptacle fire incident from becoming a major accident. Further, review of the SDR data indicates that of smoke and fire incidents occurring in the lavatory, for every trash receptacle incident there are slightly more than two incidents in other areas of the lavatory (mostly electrical in origin and frequently involving the flush pump motor). For these reasons, the FAA believes that the lavatory smoke detector will be the operative piece of equipment in preventing potential lavatory fires more often than will the trash receptacle and has assumed that of the 80 percent of all potential fire accidents expected to originate in the lavatory, an average of 45 percent of all potential accidents will involve the smoke detector as the protective equipment relied upon to prevent a major accident from developing, and only 35 percent of all potential accidents will involve the trash receptacle fire extinguisher.

These assumptions concerning the potential fire source locations and associated protective equipment are to be considered mean values of a range of values which these parameters can reasonably be expected to achieve. The FAA assumes that the proportion of potential lavatory accidents involving the smoke detector will range from 25 percent to 65 percent, distributed normally about the mean of 45 percent. Similarly, the FAA assumes that the proportion of potential lavatory accidents involving the trash receptacle fire extinguisher will range from 15 percent to 55 percent, distributed normally about the mean of 35 percent.

Estimates must also be made concerning the effectiveness of the particular piece of equipment in preventing an accident in those random combinations of circumstances where all existing safeguards have failed. The FAA assumes that given such circumstances where the lavatory smoke detector would be the relevant protective device, a catastrophic accident could be averted an average of 50 percent of the time. The FAA believes that the average effectiveness will actually be somewhat higher; however, this conservative assumption has been made for the purpose of demonstrating the desirability of the proposal in the unlikely event that the smoke detector does not prove to be as effective as expected. Potential benefits have been calculated for effectiveness values which range from 25 percent to 75 percent, distributed normally around the mean value of 50 percent.

The FAA assumes that the average effectiveness of the trash receptacle fire extinguisher will be 74 percent, with values ranging from 50 percent to 100 percent distributed normally about the mean. FAA expects the automatic fire extinguisher to be relatively more effective than the smoke detector in those circumstances in which the trash receptacle fire extinguisher would be rendered ineffective by wear and tear.

Based upon the probability distributions of the various accident parameters discussed above, probability distributions of potential benefits have been calculated for the lavatory smoke detector and trash receptacle fire extinguisher proposals and are presented in Tables 1 and 2, respectively, below:

TABLE 1.—PROBABILITY DISTRIBUTION OF BENEFITS RESULTING FROM THE LAVATORY SMOKE DETECTOR PRESENT VALUE—1983 DOLLARS

Benefit (in millions of dollars)	Probability ¹ (percent)
0	100
8.0	75
14.0	50
23.5	25
62.5	0
Expected benefit value = \$16.4 million.	

¹ That the lavatory smoke detector proposal will equal or exceed the benefits shown at left.

TABLE 2.—PROBABILITY DISTRIBUTION OF BENEFITS RESULTING FROM THE LAVATORY TRASH RECEPTACLE FIRE EXTINGUISHER PRESENT VALUE—1983 DOLLARS

Benefit (in millions of dollars)	Probability ¹ (percent)
0	100
8.9	75
17.1	50
27.1	25
69.6	0
Expected benefit value = \$19.1 million.	

¹ That the trash receptacle fire extinguisher proposal will equal or exceed the benefits shown at left.

The potential benefits of the galley smoke detector and halon 1211 fire extinguisher proposals have been estimated in a manner similar to the lavatory fire prevention proposals. As stated previously, the FAA has assumed that an average of 20 percent of potential catastrophic cabin fire accidents would involve either the galley or other general areas of the passenger cabin not previously specified. Allocation of this remaining 20 percent between the galley smoke detector and the halon 1211 extinguisher has again been approached by estimating a range of values for these parameters.

The FAA assumes that the proportion of potential catastrophic fire accidents originating in the galley area where the smoke detector will be the primary

preventive measure will range from 0 percent to 24 percent, distributed normally about a mean of 12 percent. Further, the FAA assumes that the proportion of potential cabin fire accidents where the halon 1211 extinguishers will be the critical preventive measures will range from 0 percent to 10 percent, distributed normally about a mean of 8 percent. The relatively higher proportion allocated to the galley smoke detector proposal reflects the fact that the majority of all passenger cabin fire incidents, 64.3 percent, occur in aircraft galleys. Further, many aircraft galleys are not located on the main deck of the cabin and therefore are less visible. The remaining portion of potential catastrophic accidents represents fire scenarios where the halon 1211 extinguisher would be the critical protective piece of equipment. The halon extinguisher is a state-of-the-art hand fire extinguisher which is effective against all classes of fires. However, its primary advantage over existing extinguishers is that it is especially effective against volatile liquid fires.

As in the case of the lavatory smoke detector, the FAA has conservatively estimated an average effectiveness of 50 percent for both the galley smoke detector and the halon 1211 proposals, with values ranging from 25 percent to 50 percent distributed normally about this mean.

The probability distributions of potential benefits for the galley smoke detector and halon 1211 extinguisher proposals are presented in Tables 3 and 4, respectively, below:

TABLE 3.—PROBABILITY DISTRIBUTION OF BENEFITS RESULTING FROM THE GALLEY SMOKE DETECTOR PRESENT VALUE—1983 DOLLARS

Benefit (in millions of dollars)	Probability ¹ percent
0	100
1.8	75
3.5	50
6.1	25
18.4	0
Expected benefit value = \$4.4 million	

¹ That the galley smoke detector proposal will equal or exceed the benefits shown at left.

TABLE 4.—PROBABILITY DISTRIBUTION OF BENEFITS RESULTING FROM THE HALON 1211 FIRE EXTINGUISHER PRESENT VALUE—1983 DOLLARS

Benefits (in millions of dollars)	Probability ¹ (percent)
0	100
1.2	75
2.4	50
4.1	25
12.3	0
Expected benefit value = \$2.9 million.	

¹ That the Halon 1211 proposal will equal or exceed the benefits shown at left.

The proposal which would amend the regulations specifying the location and number of hand fire extinguishers which must be available for use in designated cargo compartments, galley areas, the flight deck, and the passenger cabin of Part 121 aircraft reflects current industry practice and is expected to have a negligible economic impact on the U.S. air carrier fleet. Therefore, an analysis of benefits is not required. The basis for this conclusion is discussed further in the costs section.

Costs

The total costs of implementing the proposals to require smoke detectors in aircraft lavatories and galley areas include the cost of retrofitting approximately 15,000 galleys and lavatories installed in 2,333 passenger aircraft subject to the rule, installing smoke detectors on newly manufactured aircraft over the next 10 years, the fuel penalty resulting from the added weight of the smoke detectors, and maintenance costs. The major assumptions which have been made in developing these cost estimates include a 1-year period to retrofit the existing 1983 fleet, the use of commercially available residential-type smoke detectors at a unit cost of \$50 per installed detector, an average of 140 new aircraft manufactured each year over the next 10 years, an average additional fuel burn cost of \$3.35 per year for each 4-ounce smoke detector, an annual average cost of \$70 in maintenance labor per smoke detector, and 10 percent unit replacement rate required each year for maintenance. Because this proposal involves a new system, information on previous airline operating experience is relatively limited. Therefore, the FAA requests comments on the assumptions which it has made, particularly with respect to the feasibility of residential-type smoke detectors, and the cost of maintenance.

Table 5 summarizes the estimated total costs of \$5.9 million for the lavatory smoke detector proposal and \$3.9 million for the galley smoke detector proposal over the 10-year period following implementation.

TABLE 5.—SUMMARY OF SMOKE DETECTOR COSTS PRESENT VALUE—1983 DOLLARS

[Thousands]			
	Lavator-ies	Galleys	Both
Retrofit 1983 fleet.....	\$465.4	\$291.2	\$756.6
Newly manufactured aircraft.....	153.1	104.8	257.9
Fuel burn cost.....	226.9	151.2	378.1
Maintenance.....	5,077.0	3,384.7	8,461.7
Total cost.....	5,922.4	3,931.9	9,854.3

The costs of the proposal requiring

lavatory trash receptacles to be equipped with a fire extinguisher capable of discharging automatically upon the detection of a fire were estimated in a manner similar to that used to estimate smoke detector costs. The major assumptions which have been made in developing these cost estimates include a unit cost of \$300 per installed fire extinguisher, the assumption that 25 percent of the fleet is already equipped with these extinguishers (based upon a survey indicating that 32 percent of the aircraft operated by Air Transport Association of America (ATA) members were so equipped), the assumption that all newly manufactured Boeing aircraft will have automatic fire extinguishers installed in lavatory trash receptacles as standard equipment, an average additional fuel burn of 15 gallons per year for each 1-pound extinguisher, and a weight check every 6 months by maintenance personnel to determine the condition of each extinguisher. Table 6 summarizes the estimated \$3.9 million total costs of the automatic lavatory trash receptacle fire extinguisher proposal.

TABLE 6.—SUMMARY OF LAVATORY TRASH RECEPTACLE FIRE EXTINGUISHER COSTS PRESENT VALUE—1983 DOLLARS

[Thousands]	
Retrofit 1983 Fleet.....	\$2,094.3
Newly Manufactured Aircraft.....	101.5
Fuel Burn Weight Penalty.....	574.7
Maintenance.....	1,129.0
Total cost.....	3,899.5

The total fleet cost of equipping each aircraft with two halon 1211 hand fire extinguishers has been estimated to be \$93,000. This estimate is based upon a \$40 unit cost and the assumption that 50 percent of the fleet is already equipped with this type of extinguisher. (ATA's survey indicated that as of April 1983, 79 percent of the ATA fleet was either equipped or intended to be equipped with halon 1211 extinguishers.) However, as a result of the relatively lighter weight halon 1211 extinguishers in comparison to CO₂ extinguishers, fuel savings alone should pay for the new halon extinguishers, during the first year of operation. Further, no costs are associated with equipping newly manufactured aircraft with halon extinguishers because the price of these units is comparable with the average price of the dry chemical and CO₂ extinguishers which the halon units will replace. Therefore, the net costs of this proposal are zero.

The proposal to amend § 121.309(c) to require an increased number of hand fire extinguishers in airplanes operated under Part 121 should have a negligible economic impact on the U.S. air carrier

fleet. The airworthiness regulations applicable to nearly all transport category airplanes in the fleet require at least 3 hand fire extinguishers be located in passenger compartments of airplanes having passenger seating capacities greater than 60.

Consequently, airplanes in compliance with that rule would meet the proposed rule for passenger capacities up to 200, which includes most of the airplanes in the fleet. Larger airplanes generally carry more hand fire extinguishers than the minimum required by Part 121 and, therefore, are not expected to incur any appreciable additional costs to comply with the proposal.

Comparison of Benefits and Costs

The probability distributions of potential benefits have been compared to the estimates of costs for those proposals expected to have positive costs, providing probability distributions of the benefit/cost ratios which could result from each of these proposals. The probability of achieving benefits equal to or greater than the cost of each proposal has been identified in this manner. Further, the expected benefit values have been compared to the estimated costs, providing an expected benefit/cost ratio and an expected net benefit for each proposal. The expected benefit/cost ratio and expected net benefit represent averages of the possible benefit/cost ratios and net benefit outcomes which may be realized by each proposal, weighted by the probability associated with each outcome. Finally, the expected benefit values and estimated costs of all proposals have been totalled, enabling a comparison to be made of the benefits and costs of all of the proposals taken together.

The comparison of the benefits and costs of the lavatory smoke detector proposal is summarized in Table 7 below:

TABLE 7.—PROBABILITY DISTRIBUTION OF BENEFIT/COST RATIOS FOR THE LAVATORY SMOKE DETECTOR

Benefit (in million of dollars)	Benefit/cost ratio	Probability ¹
0.....	0	100
5.9 ²	1.0	82
8.0.....	1.4	75
14.0.....	2.4	50
23.5.....	4.0	25
62.5.....	10.6	0
Expected benefit/cost ratio = 2.8.		
Expected net benefit = \$10.5 million (based on an expected benefit of \$16.4 million).		

¹ That the lavatory smoke detector proposal will equal or exceed the benefit/cost ratio shown at left.

² Break even.

The comparison of the benefits and costs of the lavatory trash receptacle fire extinguisher proposal is summarized in Table 8 below:

TABLE 8.—PROBABILITY DISTRIBUTION OF BENEFIT/COST RATIOS FOR THE LAVATORY TRASH RECEPTACLE FIRE EXTINGUISHER

Benefit (in millions of dollars)	Benefit/cost ratio	Probability ¹ (percent)
0.....	0	100
*3.9.....	1.0	86
8.9.....	2.3	75
17.1.....	4.4	50
27.1.....	7.0	25
69.6.....	17.8	0
Expected Benefit/Cost Ratio = 4.9.		
Expected Net Benefit = \$15.2 million (based on an expected benefit of \$19.1 million).		

¹ That the trash receptacle fire extinguisher proposal will equal or exceed the benefit/cost ratio shown at left.

² Break even.

The comparison of the benefits and costs of the galley smoke detector proposal is summarized in Table 9 below:

TABLE 9.—PROBABILITY DISTRIBUTION OF BENEFIT/COST RATIOS FOR THE GALLEY SMOKE DETECTOR

Benefit (in millions of dollars)	Benefit/cost ratio	Probability ¹ (percent)
0.....	0	100
1.8.....	0.5	75
3.5.....	0.9	50
*3.9.....	1.0	45
6.1.....	1.6	25
18.4.....	4.7	0
Expected benefit/cost ratio = 1.1.		
Expected net benefit = \$.5 million (based on an expected benefit of \$4.4 million).		

¹ That the galley smoke detector proposal will equal or exceed the benefit/cost ratio shown at left.

² Break even.

The halon 1211 fire extinguisher is clearly cost-beneficial for any level of potential benefits because the proposal involves no net costs. The expected benefit value for the halon 1211 fire extinguisher is \$2.9 million in pure safety benefit.

Summing the benefits and costs of all of the proposals in this rulemaking together, total expected benefits equal \$42.8 million and total costs equal \$13.8 million, resulting in a total expected benefit/cost ratio of 3.1 and a total expected net benefit of \$29.0 million.

International Trade Impact Analysis

The proposals will have little or no impact on trade for both U.S. firms doing business in foreign countries and foreign

firms doing business in the United States. The proposals will affect only U.S. air carriers because foreign air carriers are not subject to Part 121. Foreign air carriers are prohibited from operating between points within the United States; therefore, they will not gain any competitive advantage over the domestic operations of U.S. carriers. In international operations, foreign air carriers could realize some minor cost advantages over U.S. air carriers if the foreign countries do not require similar fire protection equipment. However, these costs are negligible in comparison to the overall costs of providing international passenger services and, therefore, there will essentially be no trade impact.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by Government regulations. FAA Order 2100.14, *Regulatory Flexibility Criteria and Guidance* (dated July 15, 1983), prescribes standards for determining whether or not a rule will result in "a significant economic impact on a substantial number of small entities" as required by the RFA.

The small entities affected by the proposal are the small air carriers regulated under 14 CFR Part 121. FAA Order 2100.14 has established criteria describing what is a significant economic impact on a small air carrier and what is a substantial number of small air carriers for purposes of complying with the RFA. That order stipulates a size threshold of nine or fewer operating aircraft as the standard for small air carriers. FAA data indicate that as of April 1983, there were 45 passenger air carriers (both scheduled and unscheduled) subject to Part 121 which operated 9 or fewer aircraft.

Based upon the costing assumptions discussed previously in the economic evaluation, a typical configuration of three galley areas and three lavatories per aircraft, and applying a capital recovery factor to annualize retrofit costs over a 10-year period, the FAA has estimated that the average annualized net compliance cost for a small air carrier to meet the requirements of this proposal is approximately \$798 per aircraft.

Based on the criteria of FAA Order 2100.14 and as fully discussed in the

regulatory evaluation for this rulemaking, this proposal is not expected to have a significant economic impact on a substantial number of small entities, and a regulatory flexibility analysis is not required under the terms of the RFA.

List of Subjects in 14 CFR Part 121

Aviation safety, Safety, Air carriers, Air traffic control, Air transportation, Aircraft, Aircraft pilots, Airmen, Airplanes, Airports, Airspace, Airworthiness directives and standards, Beverages, Cargo, Chemicals, Children, Narcotics, Flammable materials, Handicapped, Hazardous materials, Hours of work, Infants, Liquor, Mail, Drugs, Pilots, Smoking, Transportation, Common carriers.

The Proposed Rule

Accordingly, the Federal Aviation Administration proposes to amend Part 121 of the Federal Aviation Regulations (14 CFR Part 121) as follows:

PART 121—CERTIFICATION AND OPERATIONS: DOMESTIC, FLAG, AND SUPPLEMENTAL AIR CARRIERS AND COMMERCIAL OPERATORS OF LARGE AIRCRAFT

1. By adding a new § 121.308 to read as follows:

§ 121.308 Lavatory and galley fire protection.

(a) After (a date 1 year after the effective date of this regulation), no person may operate a passenger-carrying transport category airplane unless each lavatory and galley in the airplane is equipped with a smoke detector system that provides a warning light in the cockpit or provides a warning light or audio warning in the passenger cabin which would be readily detected by a flight attendant, taking into consideration the positioning of flight attendants throughout the passenger compartment and galleys during various phases of flight.

(b) After (a date 1 year after the effective date of this regulation), no person may operate a passenger-carrying transport category airplane unless each lavatory in the airplane is equipped with a built-in fire extinguisher for each disposal receptacle for towels, paper, or waste, located within the lavatory. The built-in fire extinguisher must be designed to discharge automatically into each disposal

receptacle upon occurrence of a fire in the receptacle.

2. By amending § 121.309(c), by revising paragraphs (c) (1), (2), and (3); by redesignating revised paragraphs (c) (2) and (3) as (c) (3) and (4), respectively; and by adding new paragraphs (c) (2) and (5), as follows:

§ 121.309 Emergency equipment.

(c) * * *

(1) The type and quantity of extinguishing agent must be suitable for the kinds of fires likely to occur in the compartment where the extinguisher is intended to be used and, for passenger compartments, must be designed to minimize the hazard of toxic gas concentrations.

(2) At least one hand fire extinguisher must be provided and conveniently located for use in each class E cargo compartment which is accessible to crewmembers during flight, and at least one must be located in each upper and lower lobe galley.

(3) At least one hand fire extinguisher must be conveniently located on the flight deck for use by the flightcrew.

(4) At least 2 hand fire extinguishers must be conveniently located and uniformly distributed in the passenger compartment of airplanes having a

passenger seating capacity of 60 or less. For the passenger compartment of each airplane having a passenger seating capacity of more than 60, there must be at least the following number of hand fire extinguishers conveniently located and uniformly distributed throughout the compartment:

Minimum Number of Hand Fire Extinguishers

Passenger seating capacity:

61 through 200.....	3
201 through 300.....	4
301 through 400.....	5
401 through 500.....	6
501 through 600.....	7
601 or more.....	8

(5) After (a date 1 year after the effective date of this regulation), at least two of the required hand fire extinguishers installed in the airplane must contain halon 1211 as the extinguishing agent.

(Secs. 313(a), 314(a), 601 through 610, and 1102 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1355(a), 1421 through 1430, and 1502); 49 U.S.C. 106(g) (Revised, Pub. L. 97-449, January 12, 1983); 14 CFR 11.45)

Note.—Under the terms of the Regulatory Flexibility Act (the Act), the FAA has reviewed these proposals to determine what impact they may have on small entities. As discussed previously, the proposals included in this notice are only expected to affect a few small entities. Therefore, the FAA

certifies that this proposal, if adopted, will not result in a significant economic impact on a substantial number of small entities.

As discussed previously, this proposal, if adopted, is not likely to result in an annual effect on the economy of \$100 million or more, or a major increase in costs for consumers; industry; or Federal, State, or local government agencies. Accordingly, it has been determined that this is not a major regulation under Executive Order 12291. In addition, this proposal, if adopted, would have little or no impact on trade opportunities for U.S. firms doing business overseas or for foreign firms doing business in the United States.

Since this proposal concerns a matter on which there is substantial public interest, the FAA has determined that this action is significant under Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979).

A regulatory evaluation of this proposal, including a Regulatory Flexibility determination and Trade Impact Assessment, has been placed in the regulatory docket, and a copy may be obtained by contacting the person identified under the caption "**FOR FURTHER INFORMATION CONTACT.**"

Issued in Washington, D.C., on May 11, 1984.

M. C. Beard,

Director, Office of Airworthiness.

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